



PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of:

Group Art Unit: 2834

Yasumitsu IKEGAMI

Application No.: 09/142,464

Examiner: M. Budd

Filed: September 9, 1998

Docket No.: JAO 40853

For: PIEZOELECTRIC RESONATOR, METHOD FOR
MANUFACTURING SAME AND PIEZOELECTRIC
RESONATOR UNIT

APPEAL
To 2834
WILSON

BRIEF ON APPEAL

Appeal from Group 2834

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I. INTRODUCTION

A. Real Party in Interest

The real party in interest in this Appeal and the present application is Seiko Epson Corporation, by way of an Assignment filed in the U.S. Patent and Trademark Office on September 9, 1998 and recorded at reel 9838, frame 0562.

B. Statement of Related Appeals and Interferences

There are presently no appeals or interferences, known to Appellant. Appellant's representative or the Assignee, which will directly affect, be directly affected by, or have a bearing upon, the Board's decision in the pending Appeal.

C. Status of Claims

Claims 1, 3-14 and 16-26 are pending. Claims 1, 3-7, 14 and 16-20 stand finally rejected and are on Appeal. Claims 1 and 14 are independent. Claims 3-7 depend from claim 1. Claims 16-20 depend from claim 14. Claims 8-13 and 21-26 stand withdrawn from consideration. A clean version of the claims involved in the Appeal is provided in the attached Appendix.

D. Status of Amendments After Final Rejection

An Amendment After Final Rejection was filed on September 20, 2001. An Advisory Action was mailed on September 27, 2001. The Advisory Action indicated that the proposed amendments presented in the Amendment After Final Rejection would be entered upon the submission of a Notice of Appeal and Appeal Brief.

Claims 1, 4, 14 and 17 set forth in the Appendix include the proposed amendments presented in the Amendment After Final Rejection.

II. THE INVENTION

The claimed invention is directed to a piezoelectric resonator. An exemplary embodiment of the invention is shown in Figs. 1 and 2. An exemplary method of forming the piezoelectric resonator is shown in Figs. 3-6. The exemplary piezoelectric resonator

comprises a piezoelectric resonator element 5, which includes a piezoelectric body 2 and electrodes 3 disposed on the piezoelectric body. A supporting member (e.g., plug) 11 supports the piezoelectric resonator element 5. Leads 5 mechanically connect the piezoelectric resonator element to the supporting member and permit electrical connection. The leads 5 have a flat leading end portion 16, which has a substantially U-shaped edge that opens toward a leading end of the lead and defines a U-shaped opening 31. See, e.g., Fig. 3a. The flat leading end portion of the leads is connected substantially in parallel with an electrode 4 (see page 21, lines 1-6 of present specification) using a connecting layer 32 formed with a conductive resin between the flat leading end portion and the electrode 4 (see, e.g., page 18, lines 10-17 of the present specification).

The piezoelectric resonator also comprises a fixing layer 34. The fixing layer is formed of a UV-setting type resin that has a short setting time. See, e.g., page 21, lines 17-26 of the present specification. The fixing layer fixes the leading end portions 16 of the leads and the piezoelectric resonator element prior to formation of the connecting layer 32.

The piezoelectric resonator element 5 is attached to the substantially U-shaped edge 31a on a side of the piezoelectric resonator element that faces the leads. An edge of the piezoelectric resonator element on the side that faces the leads may be positioned on the substantially U-shaped edge, and the piezoelectric resonator element can be supported by the leads so that a gap 35 (see, e.g., Fig. 2) is formed between the supporting member and the piezoelectric resonator element. See, e.g., page 21, lines 7-17 of the present specification.

In some embodiments of the claimed invention, the leading end portion has a tapered cross-section converging toward its leading end. See, e.g., page 20, lines 18-25 of the present specification and Fig. 3(b).

In some embodiments of the claimed invention, the fixing layer is formed on a side of one lead facing an adjacent lead. See, e.g., page 21, last line to page 22, line 6 of the present specification, and Fig. 4(a).

In some embodiments of the claimed invention, the connecting layer is provided with a reinforcing layer of a conductive resin or a non-conductive resin, which is coated to cover at least the connecting layer and the leading end portion of the leads. See, e.g., page 25, lines 12-16 of the present specification. See also Fig. 6(b), which shows the reinforcing layer 33 formed over the connecting layer 21 and the leading end portion 16 of the lead 15.

The claimed invention provides important advantages that are described in detail below.

III. THE APPLIED REFERENCES

The applied references are:

1. WO95/24075 to Ogiso et al. ("Ogiso '075"); and
2. U.S. Patent No. 2,413,579 to Pennybacker ("Pennybacker").

IV. THE ISSUE ON APPEAL

The issue on Appeal is whether, under 35 U.S.C. §103(a), the Examiner has established a prima facie case that each of claims 1, 3-7, 14 and 16-20 would have been obvious to one of ordinary skill in the art at the time the invention was made over Ogiso '075 in view of Pennybacker.

V. GROUPING OF THE CLAIMS ON APPEAL

Under 35 U.S.C. §282, each claim of this patent application is separately patentable and upon issuance of a patent will be entitled to a separate presumption of validity. Pursuant to 37 C.F.R. §1.192(c)(7), the following groups of claims will each separately stand or fall together in this Appeal:

- I. Claims 1, 4, 6, 14, 17 and 19;
- II. Claims 3 and 16;

III. Claims 5 and 18; and

IV. Claims 7 and 20.

VI. ARGUMENT

A. The Claims are Non-Obvious

1. The Law of Obviousness/Non-Obviousness

The Patent Office has the burden to establish a prima facie case of obviousness. In re Warner, 154 USPQ 173 (CCPA 1967). According to M.P.E.P. §2143, to establish a prima facie case of obviousness: (1) "there must be some suggestion or motivation, either in references themselves or in the knowledge generally available to one of ordinary skill in the art, to . . . combine reference teachings"; (2) "there must be a reasonable expectation of success"; and (3) "the prior art . . . references when combined . . . must teach or suggest all the claim limitations" (emphasis added).

According to In re Lalu, 747 F.2d 703 (Fed. Cir. 1984), to establish a prima facie case of obviousness, "the prior art must provide one of ordinary skill in the art the motivation to make the proposed . . . modifications needed to arrive at the claim . . . [invention]." The combined teachings of the applied references must provide some teaching, suggestion or incentive to support the combination in order to establish a case of obviousness. In re Geiger, 2 USPQ2d 1276 (Fed. Cir. 1987).

According to In re Royka, 490 F.2d 981, 180 USPQ 580, 583 (CCPA 1974), to establish a prima facie case of obviousness, the Patent Office must establish that all claim limitations are taught or suggested by the prior art.

Further, analyzing the claimed invention as a whole in view of the prior art as a whole, one indicium of non-obviousness is "teaching away" from the claimed invention by the prior art at the time the invention was made. See U.S. v. Adams, 148 USPQ 479 (1966). Essentially, teaching away from a claimed invention is a per se demonstration of lack of prima facie obviousness. In re Dow Chemical Co., 6 USPQ2d 1529 (Fed. Cir. 1988). A

reference that leads one of ordinary skill in the art of the invention away from the claimed invention cannot have rendered the invention obvious. Dow Chemical Co. v. American Cyanamid Co., 2 USPQ2d 1350 (Fed. Cir. 1987).

2. The Applied References Would Not Have Rendered Obvious the Claimed Invention

a. Group I - Claims 1, 4, 6, 14, 17 and 19

Before specifically addressing the outstanding rejection, Appellant will first explain its support for the remarks below regarding the teachings of Ogiso '075. Ogiso '075 is a publication of PCT No. PCT/JP95/00311. With the exception of its Abstract, Ogiso '075 is not in the English language. U.S. Patent No. 5,867,074 to Ogiso et al. ("Ogiso '074") issued from a U.S. National Stage application of PCT No. PCT/JP95/00311. Ogiso '074 does not qualify as a reference under 35 U.S.C. § 102 with respect to the present application for the reasons stated in the Amendment filed on May 22, 2001. However, Appellant assumes that Ogiso '074 does provide an accurate English-language translation of PCT No. PCT/JP95/00311. Accordingly, to provide an accurate description of the teachings of Ogiso '075 in the following remarks, Appellant will cite to Ogiso '074, and not to Ogiso '075.

The claimed piezoelectric resonator as recited in claims 1, 4, 6, 14, 17 and 19 is neither taught nor suggested by Ogiso '075 and Pennybacker. Neither Ogiso '075 nor Pennybacker teaches or suggests a number of recited features of the claimed invention.

Namely, claim 1 recites a piezoelectric resonator, which comprises a piezoelectric resonator element having a piezoelectric body and electrodes disposed on the piezoelectric body; a supporting member supporting the piezoelectric resonator element; and a plurality of leads mechanically connecting the piezoelectric resonator element to the supporting member and permitting their electrical connection. Claim 1 recites that "each of said leads being provided with a flat leading end portion having a substantially U-shaped edge which opens toward a leading end of the leads" (emphasis added). In the final Office Action, the Examiner

admits that Ogiso '075 does not teach the recited U-shape. The Examiner refers to the surface acoustic wave resonator shown in Fig. 16 of Ogiso, including a lead 25 having a V-shaped connection end 25c. Ogiso '074 discloses at col. 12, lines 33-41, that various advantages are provided by branching the connection end 25c as shown in the figures. The branches of the connection end 25c limit the range of positioning of the connection end relative to the bump 40. That is, positioning of the bump 40 relative to the connection end 25c is constrained by the shape of the two branches. Both branches would contact the bump and prevent the bump from contacting the base of the V-shaped edge. In contrast, the claimed U-shape would not constrain the location of the bump in this same manner. Ogiso '074 discloses that "[b]y branching the connection ends into two or more sections, disposition while being combined with the bump 40 formed on the connection lands 7 can easily be performed" (emphasis added). Thus, Ogiso '074 teaches that even more than two sections (branches) can be formed. Although such further embodiments are not shown in Ogiso '074, Appellant submits that any such embodiment would be even more different from the claimed U-shape than the two-branch configuration shown in Fig. 16. Further, nowhere does Ogiso '074 teach or suggest the recited U-shape for any configuration of the connection ends, regardless of the number of the branches.

The Examiner asserts that "the U shape is well known for connection to a piezoelectric element as evidence by Penny backer [sic]". However, it is the Examiner's burden to (1) provide sufficient evidence that such U-shape is known, and (2) establish the required motivation to modify Ogiso '075 to include such U-shape. Pennybacker does not provide such evidence, nor does Pennybacker provide the required motivation to modify Ogiso '075.

Particularly, Pennybacker does not teach or suggest the claim feature that "each of said leads being provided with a flat leading end portion having a substantially U-shaped edge

which opens toward a leading end of the leads" (emphasis added). Pennybacker discloses a crystal holder that includes wires 16 connected to loops 20 provided on contact plates 18 on opposite sides of the quartz crystal 19. The loops 20 are not a part of the wires 16, but rather the loops are attached as separate connector elements to the contact plates of the quartz crystal. The loops also do not have a flat leading end portion. Thus, the loops do not have a flat leading end that has a substantially U-shaped edge opening toward a leading end of the leads. Pennybacker's connection is different from the claimed invention and does not in any way suggest the recited U-shaped edge.

Thus, Pennybacker provides no motivation to modify the Ogiso '075 connection ends 25c to achieve "leads being provided with a flat leading end portion having a substantially U-shaped edge which opens toward a leading end of the leads," as recited in claim 1. Claim 14 recites similar language regarding this feature.

Claims 1 and 14 also recite "a fixing layer made of a UV-setting type resin disposed on said piezoelectric resonator having a short setting time, the fixing layer fixing the leading end portions of said leads and said piezoelectric resonator element prior to formation of said connecting layer." As explained at page 21, line 7 to page 23, line 13 of the present specification, the recited UV-setting type resin provides a number of important advantages. Particularly, the UV-setting type resin provides a temporary fixing layer for temporarily fixing the resonator element onto the leading end portion of the lead. The UV-setting type resin can be set by the use of UV-radiation. Consequently, the temperature increase of the resonator element during setting of the resin can be limited to about 60°C. Accordingly, the much higher temperatures reached during known soldering processes can be avoided. See the paragraph bridging pages 3 and 4 of the specification. As discussed, such high heating temperatures can adversely physically affect the resonator element. In contrast, the claimed invention can avoid such detrimental effects.

Furthermore, because the recited UV-setting type resin can be fixed in very short time (e.g., about 5 seconds), a very high mounting efficiency can be achieved in the claimed invention.

In addition, the recited UV-setting type resin provides a reliable connection with sufficient strength to prevent relative positional shifting between the resonator element and the lead in subsequent mounting operations.

The recited fixing layer made of a UV-setting type resin is neither taught nor suggested by Osigo '075 or Pennybacker. Particularly, Ogiso '074 discloses the use of a conductive coupling agent 26 shown in Fig. 16. See col. 12, lines 29-32 of Ogiso '074. The coupling agent is solder or some other electrically conductive adhesive agent. However, the coupling agent is different from the recited UV-setting type resin. As stated above, the claimed invention avoids the use of high temperatures associated with the use of solder. The electrically conductive adhesive agent taught by Ogiso '074 is also different from the recited UV-setting type resin.

Ogiso '074 also discloses the use of other adhesives. Referring to the disclosure at col. 8, lines 8-29 of Ogiso '074, Fig. 7 shows an embodiment that uses a non-conductive adhesive agent 30 to mount the surface acoustic wave resonator 1 on the plug member. The leads 25c and 25d are connected to the connection lands 7a and 7b using the conductive adhesive agent 26. The adhesive agent 30 acts to reinforce the portion mounted by the cantilever method. Thus, it is clear from this disclosure that the adhesive agent 30 also is different from the claimed "fixing layer made of a UV-setting type resin disposed on said piezoelectric resonator having a short setting time, the fixing layer fixing the leading end portions of said leads and said piezoelectric resonator element prior to formation of said connecting layer."

Referring to col. 9, lines 35-64, Ogiso '074 discloses an embodiment shown in Fig. 11 that uses a non-conductive adhesive agent or spacer 35 between the ceramic case 32 and the surface acoustic wave resonator 1. As the non-conductive adhesive agent, an epoxy adhesive agent may be used that can be hardened by being irradiated with UV rays or heated. However, the adhesive agent 35 is used to attach the ceramic case 32 to the surface acoustic wave resonator 1. The adhesive agent 35 is not used for "fixing the leading end portions of said leads and said piezoelectric resonator element prior to formation of said connecting layer," as is the UV-setting type resin of the claimed invention.

Furthermore, Ogiso '075 does not teach or suggest using the adhesive agent 35 in any other disclosed embodiment. In addition to the recited UV-setting type resin, claims 1 and 14 also recite "a connecting layer formed with a conductive resin between the flat leading end portion and said electrode." However, Ogiso '075 does not teach or suggest any embodiment of the resonator unit that includes both the recited UV-setting type resin and connecting layer. Thus, for this additional reason, Ogiso '075 does not teach or suggest the claimed invention.

Pennybacker fails to provide any teaching, suggestion or motivation to modify Ogiso '075 to achieve the claimed invention. Pennybacker does not teach or suggest the recited fixing layer made of a UV-setting type resin. Thus, Pennybacker provides no motivation to modify Ogiso '075 to include the recited UV-setting type resin for "fixing the leading end portions of said leads and said piezoelectric resonator element prior to formation of said connecting layer."

Pennybacker also does not teach or suggest the recited "connecting layer."

Rather, as stated above, Pennybacker teaches the use of soldering, which the claimed invention does not use to avoid the high temperatures associated with soldering processes. Thus, Pennybacker teaches a process that the claimed invention advantageously can avoid. Therefore, because Pennybacker provides no motivation to modify Ogiso '075 with respect to

the recited UV-setting type resin and connecting layer, and, in fact, would have lead those having ordinary skill in the art away from the claimed invention. Ogiso '075 and Pennybacker would not have rendered obvious the claimed invention. Dow Chemical Co., 2 USPQ2d at 1350.

Moreover, it is well established that those portions of a reference that teach away from the claimed invention must also be considered. Bausch & Lomb, 796 F.2d 443, 230 USPQ 416 (Fed. Cir. 1986). By ignoring portions of Pennybacker that disclose the use of soldering, the Examiner has improperly failed to consider Pennybacker as a whole. In addition, Pennybacker should not be read so as to exclude those portions of its disclosure necessary to the full appreciation of what it fairly would have suggested to one having ordinary skill in the art. In re Wesslau, 353 F.2d 238, 147 USPQ 391 (CCPA 1965). The Examiner has improperly read Pennybacker by excluding those portions relating to the use of soldering.

Thus, the claimed invention would not have been rendered obvious by Ogiso '075 and Pennybacker for their failure to teach or suggest the recited features relating to the fixing layer made of a UV-setting type resin and the connecting layer.

The claimed invention would not have been rendered obvious by Ogiso '075 and Pennybacker for additional reasons as well. Namely, claims 1 and 14 each recite the feature that "said piezoelectric resonator element being attached to the substantially U-shaped edge, on a side of said piezoelectric resonator element which faces said leads, so that an edge of said piezoelectric resonator element on the side which faces said leads may be positioned on the substantially U-shaped edge" (emphasis added). See, for example, Fig. 4(a), which shows the edge 5a of the resonator element 5 matched with the end (or edge) 31a of the U-shaped opening 31 of the leading end portion 16. Consequently, because this matching can be used in manual operation and mechanical operation, positioning can be accurate and easy. See page 21, lines 7-17 of the present specification.

In contrast, Ogiso '075 does not teach or suggest any such feature. Pennybacker also does not teach or suggest this feature.

Absent the required motivation to modify Ogiso '075 to achieve the claimed invention, the applied references would not have rendered obvious the claimed invention. In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984).

Furthermore, even if the teachings of Ogiso '075 and Pennybacker were combined despite their being no motivation to do so, the combined teachings still would not have achieved all of the features recited in claims 1 and 14. Thus, a prima facie case of obviousness has not been established by the Patent Office for this additional reason. See, In re Royka, 490 F.2d at 981, 180 USPQ at 583.

For the foregoing reasons, the applied references would not have rendered obvious claim 1 or 14. Claims 4 and 6 depend from claim 1, and claims 17 and 19 depend from claim 14. Accordingly, claims 4 and 6 and claims 17 and 19 also would not have been rendered obvious by Ogiso '075 and Pennybacker for at least the same reasons stated above for claims 1 and 14, respectively. Therefore, the rejection of claims 1, 4, 6, 14, 17 and 19 should be withdrawn.

b. Group II - Claims 3 and 16

The applied references also fail to teach or suggest the features of claims 3 and 16. Claims 3 and 16 depend from claims 1 and 14, respectively. Accordingly, claims 3 and 16 include different limitations from each other. However, these claims each recite the same further limitation that the leading end portion has a tapered cross-section which converges toward the leading end thereof. See, for example, the embodiment of the claimed invention shown in Fig. 3(b), and page 20, lines 18-25 of the present specification.

In the embodiment shown in Fig. 16 of Ogiso '075, for example, the connection end 25c is deformed to increase its contact area with the conductive adhesive agent 26. See col.

12, lines 29-32 of Ogiso '074. However, the connection end of Osigo '075 is different from the recited leading end portion, which has "a tapered cross-section which converges toward the leading end thereof." As understood, Ogiso '075 does not teach or suggest any other embodiment that may include this recited feature of the claimed invention.

Pennybacker fails to cure the omissions of Ogiso '075 with respect to this feature of claims 3 and 16.

Thus, the applied references also would not have rendered obvious claims 3 and 16. Therefore, the rejection of these claims should also be withdrawn.

c. Group III - Claims 5 and 18

The applied references also fail to teach or suggest the features of claims 5 and 18. Claims 5 and 18 depend from claims 4 and 17, respectively. Accordingly, claims 5 and 18 include different limitations from each other. However, these claims each recite the same further limitation that the fixing layer is formed on a side of one lead facing an adjacent lead. For example, in the embodiment of the claimed invention shown in Fig. 4(a), the temporary fixing layer 34 is formed to face the leading end portion of the other lead.

Because the cited references fail to teach or suggest the recited fixing layer made of a UV-setting type resin, they could not have taught or suggested the features of dependent claims 5 and 18.

Thus, the applied combination of references also would not have rendered obvious claims 5 and 18. Therefore, the rejection of these claims should be withdrawn.

d. Group IV - Claims 7 and 20

The applied references also fail to teach or suggest the features of claims 7 and 20. Claims 7 and 20 depend from claims 1 and 14, respectively. Accordingly, claims 7 and 20 include different limitations from each other. However, these claims each recite the same further limitation that the connecting layer is provided with a reinforcing layer of a conductive resin or a non-conductive resin coated so as to cover at least the connecting layer

and the leading end portion of the leads. For example, in the embodiment of the claimed invention shown in Fig. 6(b), a reinforcing layer 33 covers the connecting layer 32 and the leading end portion 16 of the lead. See also, page 25, line 12 to page 28, line 3 of the present specification.

As described in the present specification, the recited reinforcing layer provides important advantages in the claimed invention. Namely, stress upon impact is dispersed throughout the reinforcing layer and stress can be absorbed by the leading end portion 16 of the leads. Also, peeling does not occur due to the presence of the connecting layer 32 and the reinforcing layer 33.

The applied references fail to teach or suggest the recited reinforcing layer, in addition to the recited fixing layer and connecting layer, as recited in independent claims 1 and 14.

Thus, the applied combination of references also would not have rendered obvious claims 7 and 20. Therefore, the rejection of these claims should be withdrawn.

VII. CONCLUSION

None of the applied references, alone or in any proper combination, disclose or suggest the piezoelectric resonator of claims 1, 3-7, 14 and 16-20.

Therefore, the Honorable Board is respectfully requested to reverse the rejections in the Final Rejection.

Respectfully submitted,


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Attachment:
Appendix

Date: December 31, 2001

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DEPOSIT ACCOUNT USE
AUTHORIZATION
Please grant any extension
necessary for entry;
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APPENDIXCLAIMS

1. A piezoelectric resonator, comprising:
 - a piezoelectric resonator element having a piezoelectric body and electrodes disposed on the piezoelectric body;
 - a supporting member supporting said piezoelectric resonator element; and
 - a plurality of leads mechanically connecting said piezoelectric resonator element to said supporting member and permitting electrical connection thereof, each of said leads being provided with a flat leading end portion having a substantially U-shaped edge which opens toward a leading end of the leads, each flat leading end portion being connected substantially in parallel with an electrode using a connecting layer formed with a conductive resin between the flat leading end portion and said electrode;
 - a fixing layer made of a UV-setting type resin disposed on said piezoelectric resonator having a short setting time, the fixing layer fixing the leading end portions of said leads and said piezoelectric resonator element prior to formation of said connecting layer; and
 - said piezoelectric resonator element being attached to the substantially U-shaped edge, on a side of said piezoelectric resonator element which faces said leads, so that an edge of said piezoelectric resonator element on the side which faces said leads may be positioned on the substantially U-shaped edge and that the piezoelectric resonator element is supported by said leads so that a gap is formed between said supporting member and said piezoelectric resonator element.
3. The piezoelectric resonator according to claim 1, said leading end portion having a tapered cross-section converging toward the leading end thereof.

4. The piezoelectric resonator according to claim 1, further comprising said connecting layer being formed with a conductive resin at least injected into a gap between said leading end portion and said electrode.

5. The piezoelectric resonator according to claim 4, said fixing layer being formed on a side of one lead facing an adjacent lead.

6. The piezoelectric resonator according to claim 1, said connecting layer being formed with a conductive resin coated onto said leading end portion or said electrode.

7. The piezoelectric resonator according to claim 1, said connecting layer being provided with a reinforcing layer of a conductive resin or a non-conductive resin coated so as to cover at least said connecting layer and the leading end portion of said leads.

14. A piezoelectric resonator unit having a piezoelectric resonator, and a hollow protector, the piezoelectric resonator comprising:

 a piezoelectric resonator element having a piezoelectric body and electrodes disposed on the piezoelectric body;

 a supporting member supporting said piezoelectric resonator element; and
 a plurality of leads mechanically connecting said piezoelectric resonator element to said supporting member and permitting electrical connection thereof each of said leads being provided with a flat leading end portion having a substantially U-shaped edge which opens toward a leading end thereof, each said flat leading end portion being connected substantially in parallel with an electrode using a connecting layer formed with a conductive resin between the flat leading end portion and said electrode;

 said piezoelectric resonator element being supported by said leads so that a gap is formed between said supporting member and said piezoelectric resonator element;

a fixing layer made of a UV-setting type resin disposed on said piezoelectric resonator having a short setting time, the fixing layer fixing the leading end portion of said leads and said piezoelectric resonator element prior to formation of said connecting layer; and said piezoelectric resonator being disposed within and sealed by said supporting member and said protector, and said piezoelectric resonator being attached to the substantially U-shaped edge on a side of the piezoelectric resonator element which faces said leads, so that an edge of said piezoelectric resonator element on the side which faces said leads may be positioned on the substantially U-shaped edge.

16. The piezoelectric resonator unit according to claim 14, said leading end portion having a tapered cross-section converging toward the leading end thereof.

17. The piezoelectric resonator unit according to claim 14, further comprising said connecting layer being formed with a conductive resin at least injected into a gap between said leading end portion and said electrode.

18. The piezoelectric resonator unit according to claim 17, said fixing layer being formed on a side of one lead facing an adjacent lead.

19. The piezoelectric resonator unit according to claim 14, said connecting layer being formed with a conductive resin coated onto said leading end portion or said electrode.

20. The piezoelectric resonator unit according to claim 14, said connecting layer being provided with a reinforcing layer of a conductive resin or a non-conductive resin coated so as to cover at least said connecting layer and the leading end portion of said leads.